4: Wilbert--50 E-4,5 (1958) 1963 SQ18 Yanoama SQ18
Chibcha SC11 Sanema
Warao SS18
Bari SS 13

/198/ Cariban Ind. SR7

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At the beginning of the year 1961 I had an opportunity, together with Dr. Layrisse, to visit the Waica of the upper Orinoco, where we went with the intention of taking blood samples of that group. We obtained 140 individual samples, which, in all probability, are representative for the Yanoama in general. We shall now report an interesting genetic discovery.

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The Waica showed a complete absence of the gene Diego (Di^a). As we reported before (Layrisse, Wilbert, 1960), the antigen Diego is an exclusively Mongoloid genetic marker, but, in spite of the fact that it occurs solely in populations called "Mongoloid," it does not appear in all of them. There are Diego-positive Mongoloids and Diego-negative Mongoloids. Gradual differences of frequency between one Mongoloid population and another have also been observed. Up to the present the scale of frequency varies between 0 and 50%.

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The Waica are one of the Diego-negative Mongoloid populations, and the tribes of South America in the same category are: the Tunebo, Barí (Motilones Bravos), and Warao. Other groups with very low incidence could be included in this category also, since the low frequency they showed for the gene can be better explained by the crossing of a population originally negative with another one highly positive. A representative of the latter group is the tribe of the Yaruro.

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During the six years of research on the Diego gene we made an observation which we consider to be of importance, which is: the various frequency groups of the Diego antigen correspond to different linguistic affinities. The most carefully studied case is that of the Caribe. We examined more than ten tribes and subtribes and they all show an average of 28% of the Di^a gene. In this case the Caribe lingnistic affinity is indicatory for a positive incidence of the Di^a gene. It is understood, of course, that there is no causal relationship between these two facts and that its observation is not to be interpreted in the sense that we are trying to make a chromosome responsible for a given cultural trait. The two factors are essentially different, but their parallel appearance is an interesting fact.

Warao SS18

Sanema

Chibcha SC11

Bari' SS13

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A linguistic connection has been observed between the Tunebo, Barí, Warao, and Yanoama, a relationship which appears to be closer than that which usually exists among all the indigenous languages of America, and, therefore, it is interesting that that group of tribes should occupy a common position and at the same time an extreme one on the distribution scale of the Di^a gene. In this case it is not a matter /199/ of a gradual difference, such as that of 12% Arawak and 28% Caribe. In this case it is a matter of an important difference between "positive" and "negative." The tribes mentioned are diametrically opposed to the Páez, Ica, and other tribes with frequencies of 45%, and this means that the Tunebo, Barí, Warao, and Yanoama are genetically distinct from their Arawak and Caribe neighbors and from the Chibcha of Colombia (Páez, Ica), but identical among themselves (speaking always of a single gene).

CBWY 143

Another observation, equally interesting, is that in general terms the cultural pattern of the tribes marked with the negative Diego is relatively uniform: they are essentially gatherers and not producers with regard to obtaining food, but their social structure and their religious concepts also seem to have many common traits which at the same time are very different from those of other native tribes of Venezuela and South America. We cannot at the present time go into this interesting point in greater detail. To sum up, we shall say that the Waica (Yanoama) are genetically similar to the Warao, Barí, and Tunebo. As all these tribes show very primitive cultural traits, it is our opinion that the absence of the Di^a gene is a characteristic of the ancient populations of South America, since it is generally accepted that the tribes called Marginal belong to an early invasion of native immigration. It is noteworthy that all the tribes speak idioms with Chibcha characteristics.

CBWY [197] Y 128

In the foregoing discussion we had to include the several Yanoama subtribes in order to try to locate the Sanemá within a larger ethnogeographic framework. We shall now concentrate more specifically on the Sanemá, due to the study of this subtribe which we made in the field. Many of the data gathered could be

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197 174 Regarding the Chibcha characteristics in the Warao and Yanoama idioms, it is probably a substratum which we shall provisionally call proto-Chibcha. The Chibcha traits which are perceived in them do not seem to represent elements acquired owing to contact, but rather an ancient stratum common to the idioms which are at the present time identified as Chibcha.

● 143 174 Finally, it is necessary to point out that, judging from the genetic constitution (the Diego antigen) of some Chibcha tribes, it might be surmised that the highly formative culture was introduced by people genetically different from the Marginal Chibcha such as Tunebo, Barí, Warao, Yanoama, whose culture was favorably conditioned in the direction of the adoption and the increment of formative cultures and indigenous civilizations. Some tribes were absorbed by the invaders; others, such as the tribes that we have just mentioned, maintained their independence. Perhaps we shall have to deal with greater emphasis in the future with primitive reminiscences in the formative cultures instead of talking so much about traits and loans from the west among the Marginals of Guayana /Guiana/ and others. We have the impression that we are bringing out a complex of ancient culture in South America, from which a number of traits have survived in the more highly developed cultures.

622 [624] [793] Political duties are performed by a chief /jefe/ and a military leader. We are of the opinion that the priest can at the same time be the chief of a local group. We cannot, however, make a categorical affirmation, owing to the confusion which exists among the people as a consequence of the strong cultural current which is invading this Sanemá nucleus. In the same group on the Ventuari we observed that the office of chief is inherited patrilineally. The old chief had left his duties to his eldest son, about 28 years old, and it was easy to see that his younger brother, about 20 years old, was also respected as a possible future chief (cf. Becher, 1960, pp. 60-61. Chieftainships over more than a local group do not exist.

BLOOD GROUP STUDIES

The Material

Blood samples were taken from 142 less closely related individuals living in six settlements situated along the banks of the upper Orinoco and Mavaca rivers in the Territorio Amazonas of southern Venezuela. We started to take samples at the Mission of Boca del Ocamo and continued along the Orinoco until we reached the confluence with the Mavaca River and then continued up the Mavaca until we arrived at the settlements called Boca Mavaca and Laguna Mavaca.

The blood samples were analyzed for the following antibodies:

(1) anti-A, anti-A_1, and anti-B for the A_1 A_2 BO system
(2) anti-M, anti-N, anti-S, and anti-s for the MNSs systems
(3) Anti-P_1 (previously called anti-P), and anti-P, anti-P_1 (previously called anti-T_j^a) for the P system
(4) anti-D, anti-C, anti-c, anti-E, anti-e, and anti-$hr^{'}$ $hr^{''}$ for the Rh system
(5) anti-Le^a for the Lutheran system
(6) anti-K and anti-k for the Kell system
(7) anti-Le^a for the Lewis system
(8) anti-Fy^a for the Duffy system. Anti-Fy^b was only used in cases Fy ($^-$)
(9) anti-Jk^a and Jk^b for the Kidd system
(10) anti-Di^a for the Diego system

Electrophoretic studies of the hemoglobins and haptoglobins were performed by Dr Tulio Arends who will report the results separately.

Results

A_1A_2BO: All samples were group O as was expected, because of the recency of contact with White and Negro.

MNSs: The gene M showed a high frequency (79%) as is usual for the majority of Indian tribes. The gene S was relatively low (19%) travelling mostly with the gene M.

Rh: The outstanding finding in this system was the high frequency of the chromosome R_o (DCE), (18%), and the low frequency of the chromosome R_2 (DcE), (6%), of which no homozygous sample was found; the frequency was deduced from the phenotype samples DCcEe. As expected, all cases were Rho(±) and no sample was found in which the presence of the chromosomes r or R_o could be presumed. Absence of the rh^o was observed in all

13a Shapiro, 1968.

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TABLE 1

Frequency of blood group antigens in Waica Indians

Phenotypes / Genes or chromosomes	Observed		Expected		χ^2		
	Absolute Number	Frequency %	Frequency %	Absolute Number			%
A_1A_2BO system							
A_1	0.	0.00					
A_2	0.	0.00					
B	0.	0.00					
O	141	100.00					
MNSs system							
MMSS	1	0.71	1.63	2.30	0.15		
MMSs	27	19.15	16.84	23.74		MS	12.76
MMss	62	43.97	43.51	61.36	0.01		
MNSS	1	0.71	1.34	2.17	0.09	Ms	63.97
MNSs	17	12.06	11.85	16.71			
MNss	24	17.02	20.09	28.33	0.66		
NNSS	1	0.71	0.37	0.52	0.25	NS	6.04
NNSs	3	2.13	1.84	2.59		Ns	15.23
NNss	5	3.54	2.32	3.27	0.91		
	141	100.00	100.00	140.99	2.02		100.00
					n = 5		
					0.90>P>0.80		
Rh system*							
DCCEE	6	4.26	3.40	4.79	0.08	DCE	18.44
DCCEe	36	25.52	27.72	39.09			
DCCee	81	57.45	56.51	79.68	0.02	DCe	75.17
DCcEE	4	2.84	2.36	3.32	0.08		
DCcEe	14	9.95	9.80	13.54			
DCcee	0	0.00	0.00	0.00		DcE	6.39
DccEE	0	0.00	0.41	0.58	0.58		
DccEe	0	0.00	0.00	0.00			
Dccee	0	0.00	0.00	0.00			
	141	100.00	100.00	141.00	0.76		
					n = 3		
					0.70>P>0.50		

* Six samples of the phenotype DCCEE, four samples DCcEE, and one sample DCcEe were not agglutinated with anti-hr'.

BLOOD GROUP ANTIGEN TESTS

Table 1 (cont'd)

Frequency of blood group antigens in Wales Indians

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Phenotype	Observed Absolute Number	Observed Frequency %	Expected Frequency %	Expected Absolute Number	χ^2	Gene or chromosome	%
P system							
P_1	81	57.45	–	–	–		34.77
P_2	60	42.55	–	–	–		65.23
P	0	0.00					0.00
	141	100.00					100.00
Duffy system							
Fy(a+)	117	82.98				Fy^a	58.75
Fy(a–)	24	17.02				Fy^b	41.25
	141	100.00					
Kell system							
KK	0	0.00	–	–	–	K	0.00
Kk	0	0.00	–	–	–		
kk	141	100.00	–	–	–	k	100.00
Lewis system							
Le(a+)	0	0.00					
Le(a–)	141	100.00					
Kidd system							
Jk(a+b–)	34	24.11	31.39	44.26	2.38		
Jk(a+b+)	90	63.83	49.28	69.48	6.06		
Jk(a–b+)	17	12.06	19.33	27.26	3.86	Jk^a	56.03
	141	100.00	100.00	141.00	12.30	Jk^b	43.97
					>P>0.001		100.00
Diego system							
Di(a+)	0	0.00				D^a	0.00
Di(a–)	141	100.00				Di	100.00

phenotype samples but one of which failed to react with the common anti-e. The absence of the chromosome Dce and dce and the high frequency of the chromosome DCE is apparently against the crossing-over hypothesis of Fisher[14] which presumes that the occasional crossing-over of the high fre-

14 Race and Sanger, 1950.

St Layrisse et al. D, E-S (ca. 1960)1961 SQ18 Taxonomy SQ18
Wales

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quency chromosomes DCe and DcE in Indians could maintain the low frequency of the chromosomes Dce or dce and DCE.

P: As in all South American tribes the gene P_1 was below 40%.

Lutheran, Kell and *Lewis:* All cases were Lu (a—), K (—) and Le (a—) confirming the lack of admixture with White and Negro populations.

Duffy: Twenty four samples were Fy(a—) but all of them were agglutinated by anti-Fy^b, ruling out the presence of the gene Fy. The Fy^a frequency, although low (38%), is on the range found in other South American aborigines.[16]

Kidd: The Jk^a frequency (36%) is on the usual range observed in American Indians.

Diego: All samples were Di(a—). We will comment fully on this finding in the discussion.

Frequency of Antigens of the Ten Blood Group Systems in Marginal Tribes

Tribes on a Paleo/Meso-Indian level of culture development have conventionally been designated by the term "Marginals." *Physical anthropologists*[16] have called *Marginal American Indians* such groups who are predominantly dolichocephalic, somewhat Mongoloid, and predominantly non-agricultural.

So far we have analyzed three of the above defined Marginal tribes: the Warao,[17] the Yaruro,[18] and the Waica. Comparing the blood group antigens tested in these tribes, we found the following results in each blood group system:

ABO: As had been expected of almost isolated tribes, all individuals tested were group O.

MNSs: The Warao were aberrant, showing a very low frequency of M (42%), as compared with Yaruro (78%) and Waica (79%). The Ss antigens were tested only in Yaruro and Waica, showing similar results.

P: This system was tested only in Yaruro and Waica which showed low frequencies of the gene P_1 (38% and 33% respectively), as is observed in the majority of South American Indians.

Rh: They showed a similar frequency for the chromosome R_1 (DCe), ranging from 63% to 78%, but the frequencies of the R_2 (DcE) and R_o (DCE) were quite different. While at R_2 the Waica were aberrant in showing only 6%, the Yaruro and Warao showed 26% and 27% respectively; at R_o the aberrants were the Yaruro who lacked this chromosome while the Warao and Waica had an incidence of 5% and 18% respectively.

13 Layrisse, Layrisse, and Wilbert, 1960, 1961; Layrisse, Layrisse, Garcia, and Wilbert, 1961.
16 Coon, Garn, and Birdsell, 1950.
17 Layrisse, Arends, and Wilbert, 1958.
18 Layrisse, Layrisse, Garcia, and Wilbert, 1961.

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Waica

Duffy: The Fy (a+) ranged in these tribes from 77% to 92%, which is the usual range found in Indian tribes. 143

Kidd: The gene Jk^a showed comparable results in Yaruro 49% and in Waica 56%. The Warao were not tested for this gene.

Diego: As was mentioned before, the Waica showed absence of the gene Di^a; the Warao had a negative frequency among the Winikina sub-tribe and 1.9% among the Guayo sub-tribe; the Yaruro showed five Diego-positive cases out of 102 samples, but four of them were derived from eleven samples taken from a single band. For reasons mentioned elsewhere, the authors suggested that the Warao as well as the Yaruro were originally Diego-negative, and that their low Di^a frequencies are due to admixture with neighboring tribes exhibiting a relatively high frequency of the gene.

Other Blood Groups

The tribes tested for Lutheran, Kell, and Lewis showed negative frequency for Lu^a, K, and Le^a, as is seen also in other Indian tribes with non-Indian admixture.

As can be gathered from these comparisons, it is mainly on the basis of the Di^a gene that we could establish a sharply contrasting difference between the Marginal tribes and other South American tribes tested so far (Goajiro 8%, Paraujano 10%, Mundurukú 12%, Guahibo 14%, Caingang 17-46%, Aymara 17%, Caribs [Cariña 29%, Pemon 28%, Yupa 27%]), etc. . .

DISCUSSION

In a previous section we have tried to indicate that the absence or a very low frequency of the Diego gene appears to coincide with a culture pattern typical for hunting, fishing and gathering tribes of South America. On several other occasions [19] it has been pointed out as well that there seems to exist a coincidence of certain levels of cultural developments with characteristic ranges of Diego frequencies, and that these frequencies tend to be quantitatively similar or identical between tribes of "genetic" linguistic affiliation, in the sense Greenberg [20] uses the term. For Venezuela we have, in particular, made mention of the low frequency or absence of the Diego gene among the Waica, Warao, and Yaruro who exhibit a Marginal or Paleo/Meso-Indian type of culture. 143 114 104

We have also indicated that this parallel occurrence of Diego gene distribution and the culture pattern of its bearers coincides to a certain extent with a similar

19 Layrisse and Wilbert, 1966.
20 Greenberg, 1959.

St Layrisse et al. D, E-8 (ca. 1960)1962 SQ18 Yanoama SQ18
Waica

classification, based on somatological and phenotypical characteristics of the American Indians as proposed by Coon, Garn, and Birdsell,[21] who distinguished between dolicephalic and somewhat mongoloid *Marginal American Indians*, and broader headed less mongoloid *Central American Indians*. *As a parallel and, of course, not as a causal phenomenon*, the cited authors (very much like the present authors) record that the *Marginal American Indians* include largely non-agricultural Indians of the Americas, while the latter are agricultural peoples of North and South America, especially of the central part. This observation receives substantial support from the recorded facts of the Diego gene distribution, and its importance for migration theory and culture history of South America may be significant. In the given frame of the present paper we shall restrict ourselves to the discussion of the importance of the absence of the Diego gene mainly among two Marginal tribes of Venezuela, the Waica and the Warao, trying to indicate a possible direction for future Diego research.[21a]

In a recent study, Canals Frau[22] observed that the oldest stratum of *Homo sapiens* in America was composed of five distinct racial types, i.e., the *Silvidos*, the *Sonóridos*, the *Láguidos*, the *Patagónidos*, and the *Huárpidos*, and that the last three were of South American distribution. It is interesting to recall in this connection that Canals Frau includes the Waica and the Piaroa in this antique stratum within which great phenotypical variation has been observed by Vinci, for the Yanoama, and by Baumgartner for the Piaroa.[23] It would seem that the actual occurrence of this variation in one and the same group could best be interpreted by fusion and interbreeding of the different racial types of Paleo-American Man.

Because of his early appearance, the culture of this Paleo-American Man will necessarily have been on a Paleo-Indian (hunters), and later Meso- Indian (fishermen) level of development.[24] Kirchhoff,[25] in referring to the hunting and fishing Marginals of Venezuela, observed that the "differences in subsistence are correlated with other cultural differences, indicating that there was not one basic culture type, but two, the Hunting Culture and the Fishing Culture;" that "Each in turn was divided into at least two subtypes," and that "Without further comparative research, it is impossible to say whether these subtypes were simply local variants of the two basic types or whether they too sprang from different origins."

21 Coon, Garn, and Birdsell, 1950.
21a Layrisse and Wilbert, 1963.
22 Canals Frau, 1959.
23 Vinci, 1936; Zamora, 1939; Baumgartner, 1954.
24 Cf. Rouse, 1960.
25 Kirchhoff, 1948, p. 449.

The most typical representative of the Hunters among modern Venezuelan Indians are the Yanoama, while the most typical example of a people of Fishermen culture can be seen in the Warao. It is interesting for the discussion of Kirchhoff's problem that Swadesh (personal communication) suggests a linguistic affiliation between Yanoaman and Waraoan; interesting, because it is generally accepted that "genetic" linguistic relationship is most likely to have biological significance, since the ancestors of the speakers of genetically related languages[26] once belonged to the same gene pool.

In following up Swadesh's suggestion, the present authors have compared (a) the basic vocabularies of Yanoaman and Waraoan, and (b) all available pairs of about 1000 Yanoama (Sanemá) words with their equivalents in the Warao dictionary recently published by Barral.[27] As a result of this comparison, more than twenty percent of the total pairs compared appeared to be cognate; a percentage certainly high enough to encourage further research. A preliminary glottochronological calculation resulted in 45 mc of separation, which corresponds to twenty six percent of common retentions. Accepting this result as a strong *prima facie* case, it would suggest that the *Yanoama* and *Warao* originally united, separated from each other some 4,500 years ago.[28]

If we compare the blood group phenotype frequencies found in these two tribes, we see that only the frequencies at Diego are very similar, whereas MN, Rh, and Duffy showed statistically significant variations. It is generally accepted that significant differences of gene frequencies in two populations are indicative of different origin, but in comparing small isolated populations, such as most Indian tribes, this statement may not be applicable without allowing for certain restrictions. The gene frequencies in these populations may, for instance, reflect the fortuitous results of gene drift, since in a population with an effective size of 200, an allele would require a selective advantage of 0.01 to avoid the action of drift.[29]

In our case, we are comparing the gene frequencies of blood groups, the majority of which have, until now, been considered to be of neutral selective value. Although the Waica and the Warao belong to the most numerous Indian tribes of Venezuela and lowland South America (8-10,000), they have been living in smaller isolated groups which might have favored the production of gene drift. On this basis, then, one could consider gene drift as the most probable explanation for the phenotype differences of the Rh, MN, and Duffy systems, especially, if we take into consideration a possible 4,500 years lapse of time since their separation.

26 Greenberg, 1955.
27 Barral, 1957.
28 Wilbert, 1961b.
29 Glass, Sacks, Jahn, and Hess, 1952.

St Layrisse et al. D, E-5 (ca. 1960)1962 SQ18 Yanoama SQ18
Waica

We would best interpret our general culture historic problem in the sense of suggesting that there exists a high probability for the two different populations and culture types to represent simply variants of basically the same people and the same culture type. Archaeologists[30] have proved that the Meso-Indian culture type dates back to 4150 ± 80 BP (Manicuare), so that the *Warao* Meso-Indian culture type could actually date back to the time of their splitting off from the *Yanoama* who, for their part, continued to live in the Paleo-Indian tradition, and which, in turn, may date back to its most original form in Venezuela to 16,000 ± 300 BP and more.

In our particular case, then, the establishment of the genetic identity of two tribes with respect to the Diego blood gene has led us to assume that Paleo-American Man in Venezuela, although phenotypically different, is homogeneous for the Diego gene. Probably, in response to a changing environment, he developed two different culture types still traceable among his modern descendants. A detailed analysis of the contents of both cultures would greatly substantiate this hypothesis, but in the limited frame of the present paper we shall have to refrain from doing so.

In closing this discussion, we would like to underline the preliminary character of our hypothesis. The culture content of the Waica and of the Warao has not been fully described as yet; the linguistic affiliation of the two tribes remains to be confirmed by profound linguistic analysis; and genetically we have little more to go by than the behavior of mainly one gene. Nevertheless, taken together this kind of threefold evidence, in spite of all the existing limitations, appears to be much stronger than the single evidence available for any one of them, and it would be highly desirable to test similar cases along the lines described above.

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30 Crossen and Kraus, 1950-59, vol. 1, tables 2 and 3.